भारतीय मानक
Indian Standard

IS 8472 : 2019

स्वच्छ, शीतल जल के लिये अपकेंद्री पुनर्योजी पम्पों की विशिष्टि

(दूसरा पुनरीक्षण)

Centrifugal Regenerative Pumps for Clear, Cold Water — Specification

(Second Revision)

ICS 23.100.10

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April 2019 **Price Group 7**

Pumps Sectional Committee, MED 20

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Mechanical Engineering Divisional Council.

This standard was first published in 1977 and subsequently revised in 1998. The major changes in the first revision were:

a) To align the method of verification of guarantee with the other pump standard like IS 9079, IS 8034 and IS 6595.
b) To incorporate the requirements of self priming characteristics in case of self priming and semi-self-priming pumps.

Since, then three amendments were issued.

In this revision, all the amendments have been reviewed and incorporated.

The following changes have been made in the second revision of this standard:

a) Basic working principle of pumps elaborated with figures;
b) Figure locations are rearranged to have better linkages with text;
c) On assembly line optional air pressure testing has been proposed for leakage test, provided casing halves has passed hydrostatic test at component level. This will prevent rusting and jamming of pumps;
d) Temperature rise at higher and lower voltages have been proposed to make the product more reliable and better for varying Indian Voltage conditions;
e) Ingress Protection (IP) has been added in the marking requirements as is required for the safety of equipment;
f) Performance parameters of prime mover (motor) has been updated for 2 pole and added for 4 pole; and
g) Self priming test is revised at 4 m suction lift with maximum time limit of 180 s.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CENTRIFUGAL REGENERATIVE PUMPS FOR CLEAR,COLD WATER — SPECIFICATION

(Second Revision)

1 SCOPE

This standard specifies the technical requirements for centrifugal regenerative pumps that is, repeated centrifugal action pumps for handling clear, cold water. The pump may be constructed either as a bare pump or monoset in single or multi-stage construction.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this Standard. The Standards contain provisions which through reference in this text, constitute provisions of the Standards. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 TYPES

3.1 Regenerative pump designs are mainly of two types (Fig. 1A and 1B):

a) Side channel — Examples given in Fig. 7 and 8, and

b) Peripheral — Examples given in Fig. 6, 9 and 10.

3.2 In terms of their design capabilities, the pumps may be further categorized as:

a) Non self priming, or

b) Self priming.

3.2.1 *Non-self-Priming*

It is that type of regenerative pump which cannot prime without a foot valve (*see* Fig. 9).

3.2.2 *Self-Priming*

It is that type of regenerative pump which is capable of priming up to 4 m static suction lift at mean sea level and water temperature 33ºC at rated head and discharge, without a foot valve. *See* Fig. 6, 7, 8 and 10.

4 PRINCIPLE OF OPERATION

The design of the pump includes a special impeller with a large number of radial blades. As the fluid is discharged from one blade, it is transferred to the root of the next blade via channel and gains additional energy. The liquid enters and exits the blades and channel during several revolutions of the impeller. The increase in velocity and pressure of the liquid are therefore gradual as compared to the centrifugal pump. In these pumps the energy transfer takes place by centrifugal regeneration in series of impeller pockets and the casing channel. It is illustrated in Fig. 1.

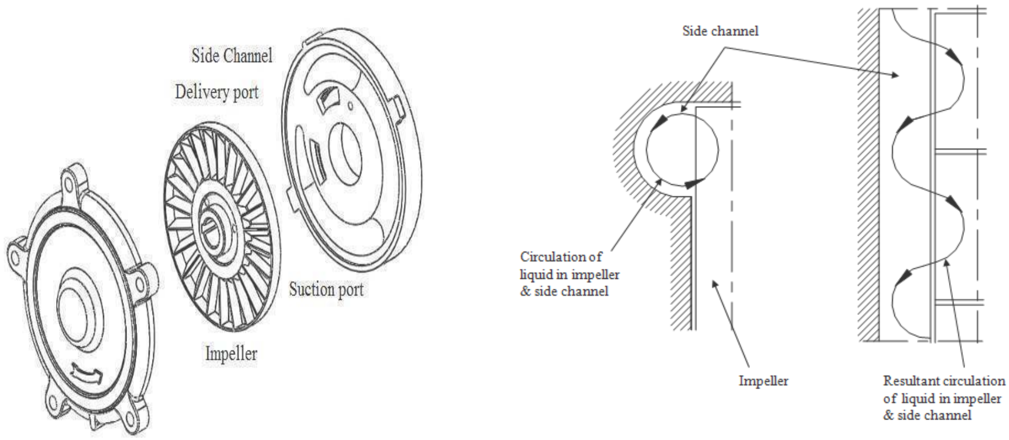

Side Channel
Delivery port
Suction port
Impeller
Side channel
Circulation of liquid in impeller & side channel
Impeller
Resultant circulation of liquid in impeller & side channel

FIG. 1A SIDE CHANNEL PUMP

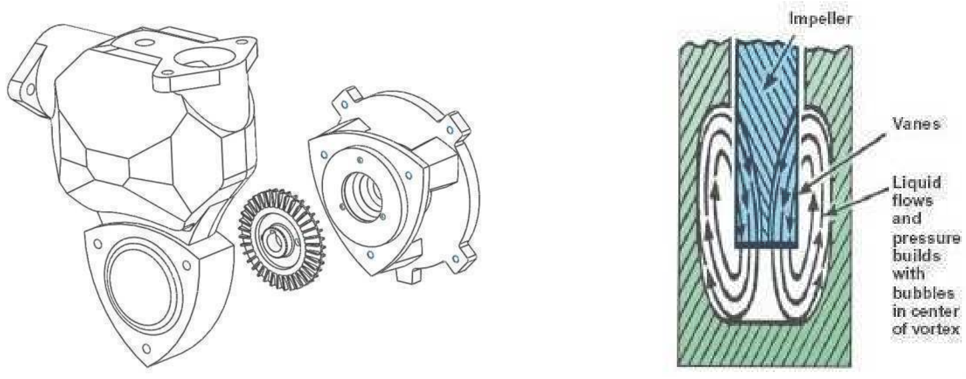

Impeller
Vanes
Liquid flows and pressure builds with bubbles in center of vortex

FIG. 1B PERIPHERAL PUMP

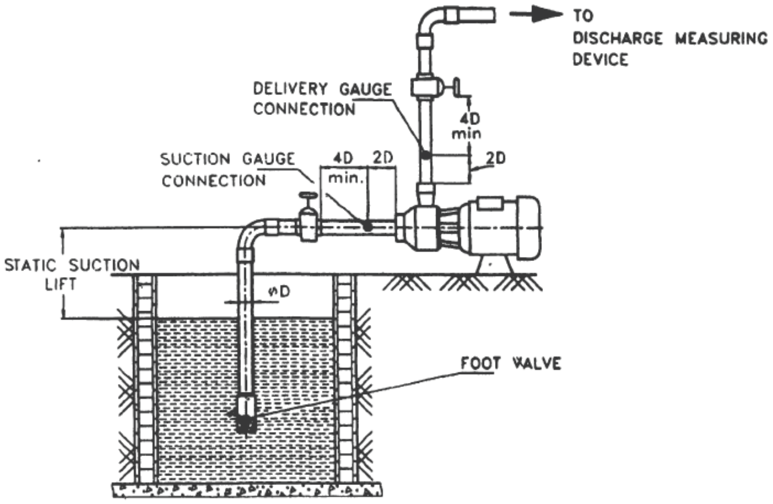


FIG. 2 NON-SELF PRIMING MONOSET PUMP TEST SET-UP

4.1 Pump Working Principal

As fluid moves from the inlet to the outlet, pressure increases continuously in the vicinity of each impeller blade of the regenerative pump, with the subsequent passes through the impeller channels adding energy to the vortex. This energy magnifies itself as pressure.

5 UNITS, TERMINOLOGY AND CLASSIFICATION

5.1 Units, terminology and classification relating to pumps shall be as specified in IS 5120 and for motors as specified in IS 14582 and IS 7538.

5.2 In addition the following terminology shall also apply.

5.2.1 *Manometric Suction Lift*

It is the vacuum gauge/ liquid column manometer/ transducer reading in meters of water column.

5.2.2 *Static Suction Lift*

It is the vertical distance between the pump centre line and the water level (*see* Fig. 2, 3, 4 and 5).

5.2.3 *Clear, Cold Water*

Characteristics of clear cold water are specified below:

a)	Turbidity	50 ppm (silica scale), *Max*
b)	Chlorides	500 ppm, *Max*
c)	Total solids	3 000 ppm, *Max*
d)	pH value	6.5 to 8.5
e)	Temperature	33°C, *Max*
f)	Specific gravity	1.004, *Max*
g)	Hardness (as $CaCo_3$) (drinking water)	300 mg, *Max*

NOTE — If the characteristics of water differ from these specifications, the pump constructional details shall be agreed between the manufacturer/supplier and the user. In such cases, the characteristics shall be specified in the order.

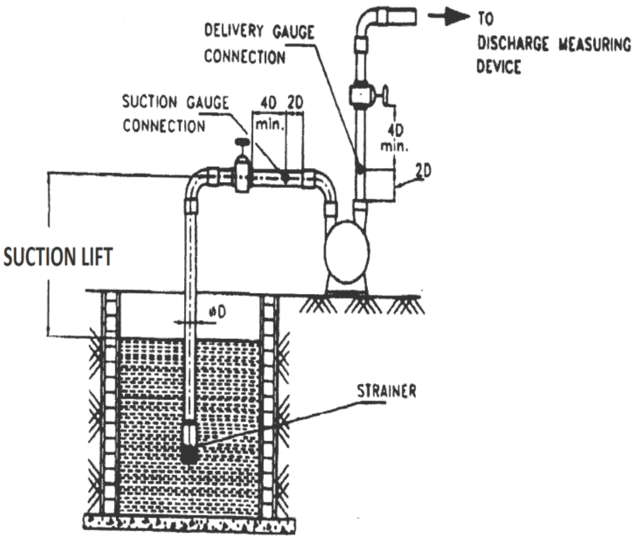


FIG. 3 Typical Self Priming Pump Test Set-Up—Option 1

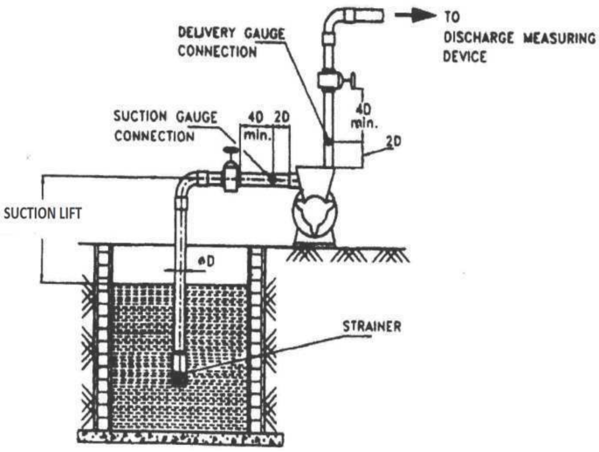


FIG. 4 Typical Self Priming Pump Test Set-Up— Option 2

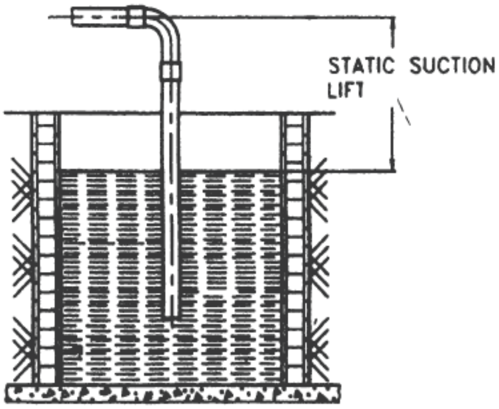
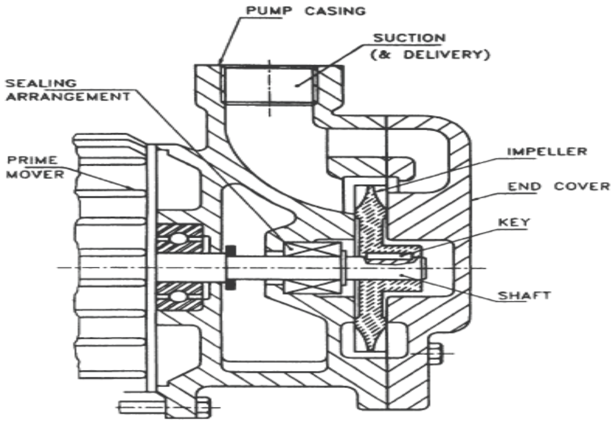


FIG. 5 Test Set-Up For Self Priming Test

6 NOMENCLATURE

Nomenclature of the components commonly used in regenerative pumps shall be as given in Fig. 6, 7, 8, 9 and 10. Nomenclature of the motor parts shall be as given in IS 1885 (Part 35).



(*Prime Mover means MOTOR*)

FIG. 6 Typical Regenerative Self Priming Monoset Pump (Peripheral Type)

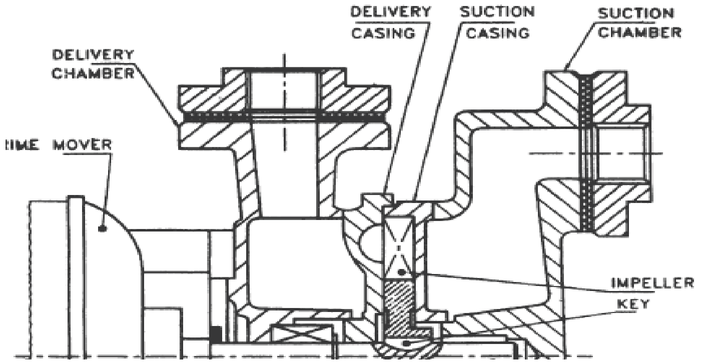


FIG. 7 Typical Regenerative Self Priming Monoset Pump (Side Channel Type)

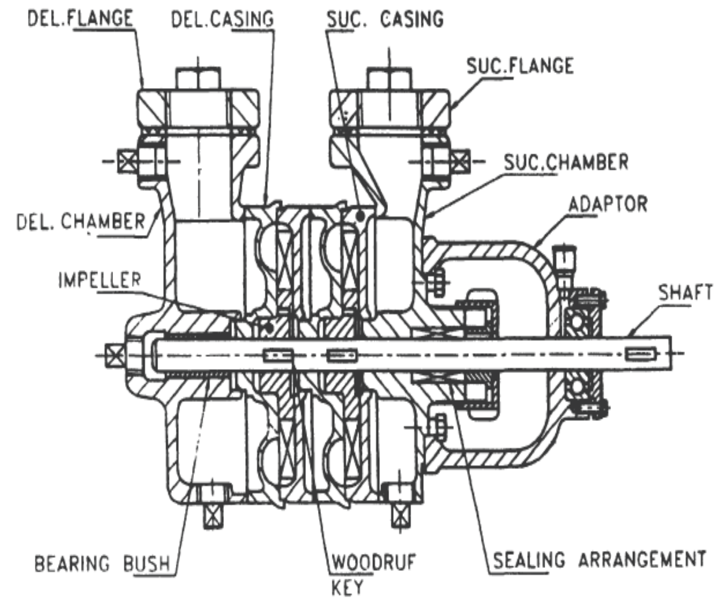
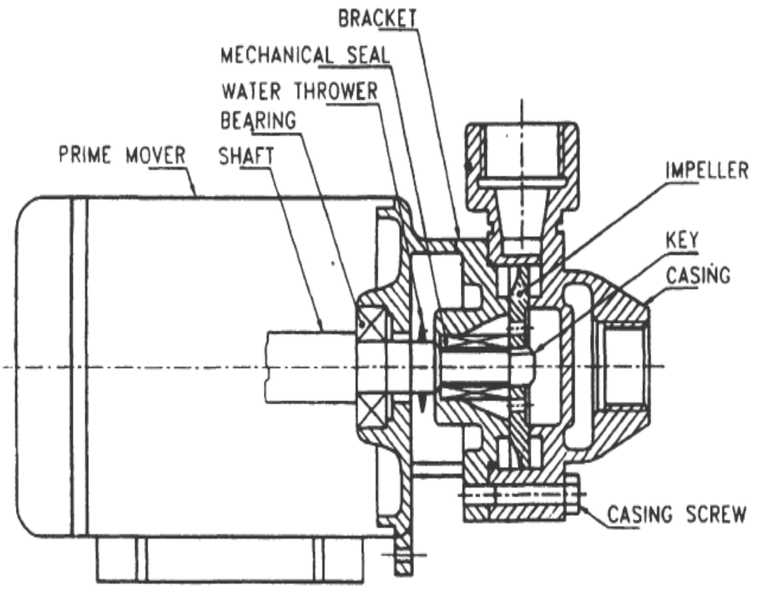
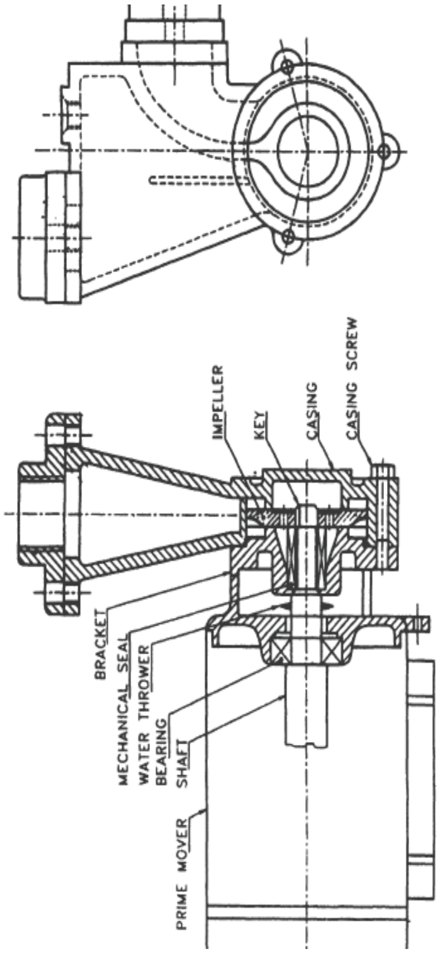


FIG. 8 Regenerative Pump (Side Channel Multi-Stage Type)



(*Prime Mover means MOTOR*)

FIG. 9 Typical Regenerative Non Self Priming Pump (Peripheral Type)



(*Prime Mover means MOTOR*)

FIG. 10 Typical Regenerative Self Priming Pump (Peripheral Type)

7 MATERIALS OF CONSTRUCTION

It is recognized that a number of materials of construction are available to meet the needs for pumps handling clear, cold water. A few typical materials are indicated below merely for the guidance of the manufacturers and the users.

Sl No.	*Component*	*Materials of Construction*
i)	Pump Casing/ Chamber	Grey cast iron grade FG 200 of IS 210, Bronze grade LTB 2 of IS 318 cast stainless steel
ii)	Impeller	Forged brass grades FLB, FHTB3, FHTB4, FHTB and F Mn B of IS 6912 Bronze grade LTB 2 of IS 318 High tensile brass casting grade HTB1 and HTB2 of IS 304 Cast / Forged Stainless Steel
iii)	Shaft	CS Gr. 40C8 of IS 1570 P-2, Stainless Grades X04Cr12, X12Cr12 and X20Cr13 of IS 6603

8 DIRECTION OF ROTATION AND FLOW PASSAGES

8.1 The direction of rotation of pumps is designated clockwise or anti-clockwise as observed when looking at the pump shaft from the driving end.

8.2 The direction of rotation shall be clearly marked either by incorporating an arrow in the casting or by a separate sheet metal arrow fitted to the pump at a clearly visible place.

8.3 The direction of inlet and outlet flow passages of the pump shall be marked in the casting.

9 FACTORS AFFECTING PUMP PERFORMANCE

9.1 The degree of compliance of pump components and assembly to the specified requirements affects the pump performance since the dimensional tolerances and clearances required for these pumps are critical.

9.2 Under identical suction conditions with increase in usage of such pumps or wear of impeller and casing, the self-priming time increases; and the head and discharge decreases.

10 DESIGN FEATURES FOR MONOSET PUMPS

10.1 Voltage and Frequency Variation

Motor of the monoset pumps shall be capable of operating in the following range of supply Voltage and frequency:

a) Voltage ranging between +6 percent and -15 percent of the rated value;

b) Frequency ranging ±3 percent of the rated value; and

c) Any combination of a) and b) above.

11 GENERAL REQUIREMENTS

11.1 The pump shaft should be of adequate size to transmit the required power over the entire head range.

11.2 The pump casing should be of robust construction and shall be tested to withstand hydrostatic pressure as specified in **12.3**.

11.3 The nominal size of suction and delivery pipe of the pump shall be as specified in IS 1239 (Part 1), IS 4984, IS 4985 and IS 12231.

12 PUMP TESTS

12.1 The testing equipment, test set-up and observations for the pumps shall be in accordance with IS 11346 except for the pumps having vertical axis suction port, the test set-up shall then be as given in Fig. 3. In addition to the above, a self-priming test shall also be carried out as specified in **12.5**.

12.2 *Sampling*

The sampling and criteria of conformity shall be according to IS 10572.

12.3 *Hydrostatic Test*

Pump casing shall be tested to withstand 1.5 times the working pressure of the pump for at least 30 s.

12.3.1 If all components comprising of the pump casing passes the hydrostatic test as per **13.3** before assembly, then during routine testing of the assembled pump the packing and seal leakage detection shall be done with pressurized air at 1 kg/cm^2. Else the hydrostatic test shall be carried out as per **13.3** during routine testing of the assembled pump.

12.4 The pump shall be capable to perform as per guaranteed duty point at a manometric suction lift of 4 m at mean sea level and water temperature of 33°C. While carrying out the above test, correction shall be applied to manometric suction lift for altitude at the test place and water temperature other than 33°C, as specified in IS 11346.

12.5 Self-Priming Test for Self-Priming Pumps

The pump shall be tested for self-priming time at a minimum static suction lift of 1.5 m for semi self priming and a minimum static suction lift of 3 m for self-priming pump. While carrying out the above test, correction shall be applied to static suction lift for altitude at the test place and water temperature other than 33°C, as specified in IS 11346. The test procedure shall be as follows:

No check or foot valve or any other external means of priming shall be installed in the suction pipe line. Fill pump casing with water and start the unit. The priming time shall be the total elapsed time between starting the unit and to obtain a continuous flow through the delivery pipe (*see* Fig. 5)

12.5.1 *Priming Time Conversion Factor*

If a pump is connected to a larger pipe than the nominal pipe size of the pump on the suction side, it is necessary to compute the performance for the nominal pipe size of the pump. For ease of reference, the conversion factors are given in Table 5. The method of finding the conversion factor is as explained below:

a) Select the size of the suction pipe actually used in the test;
b) Follow the line horizontally right to the vertical column under the heading size of nominal pipe;
c) The figure shown at the intersection is the conversion factor;
d) Divide the test time (in seconds) by this factor and then divide the resultant by the total vertical length of the of the suction pipe above water level in meters. This gives the average time, in seconds for air removed from a suction line of nominal size per meter of length.

12.6 The observations of test shall be recorded in a test record sheet. A specimen sheet is given in **Annex-B**.

12.7 Bare pumps shall be tested using calibrated prime-mover.

13 TESTS FOR ELECTRICAL PERFORMANCE

The routine and type tests on monoset pumps shall be performed as specified in **13.1** and **13.2**. The general requirements of the motor with regard to type of enclosures, methods of cooling, duty rating and earthing should be in accordance with IS 14582 or IS 7538.

13.1Single Phase Monoset Pump

13.1.1 *Routine Test*

The routine test shall comprise (a), (b), (c), and (d) of **16.3** of IS 14582.

13.1.2 *Type Test*

The type test shall comprise a), b), c), d), k), and m) of **16.2** of IS 14582, and the temperature rise test given in **14.1.2.1.** The test for full-load performance shall comprise rated output, full-load speed and full-load current of the motor.The type test shall be conducted in 1 out of 200 pumpsets or less, of identical type and design manufactured in a month.

13.1.2.1 *Temperature-rise test*

13.1.2.1.1 *At rated voltage*

Temperature rise test shall be conducted for the maximum current in the declared operatinghead range at rated voltage and supply frequency. The temperature rise shall not exceed the limits specified in Table 7 of IS/IEC 60034-1

13.1.2.1.2 *At extreme voltage*

Temperature rise test shall be conducted at 85 percent of the rated voltage and supply frequency with the same load as in **14.1.2.1.1**. The temperature rise shall not exceed the limits specified in Table 7 of IS/IEC 60034-1 by more than 10°C.

13.2 Three Phase Monoset Pump

13.2.1 *Routine Test*

The routine test shall comprise a), c), d), e) and f) of **22.3.2** of IS 7538.

13.2.2 *Type Test*

The type test shall comprise b), c), d), e), m) and n) of **22.3.1** of IS 7538 and the temperature –rise test given in **14.2.2.1.** The test for full-load performance shall comprise rated output, full-load speed and full-load current of the motor.The type test shall be conducted in 1 out of 200 pumpsets or less, of identical type and design manufactured in a month.

13.2.2.1 *Temperature rise test*

13.2.2.1.1 *At rated voltage*

Temperature rise test at rated voltage shall be conducted for the maximum current in the declared operating head range at rated voltage and supply frequency. The temperature rise shall not exceed the limits specified in Table 7 of IS/IEC 60034-1.

13.2.2.1.2 *At extreme voltage*

Temperature rise test shall be conducted at 85 percent of the rated voltage and supply frequency at the same load as in **14.2.2.1.1**. The temperature rise shall not exceed the limits specified in Table 7 of IS/IEC 60034-1 by more than 10°C.

14 PRIME-MOVERS FOR BARE PUMPS

14.1 Engine

The engine shall conform to IS 7347 or IS 11170 as applicable.

14.2 Electric Motor

Single phase motors shall conform to IS 14582 and three phase motors shall conform to IS 7538. The motor shall withstand the routine and type test specified in **14**.

15 GUARANTEE ON PUMP PERFORMANCE AND TOLERANCES

15.1Guarantee of Workmanship and Material

The pump shall be guaranteed by the manufacturer against defects in material and workmanship when used under the conditions specified in this standard, for a period of at least 15 months from the date of dispatch or 12 months from the date of commissioning, whichever is earlier.

15.2 Guarantee of Performance

When tested in accordance with **12**, the pumps shall be guaranteed for its performance as given below.

15.2.1 *Monoset Pump*

a) Discharge, total head, current and input power at the guaranteed duty point at rated conditions of voltage and frequency. The declared current and input power at guaranteed duty point shall be less than or equal to the maximum value specified in Table 1, 2, 3 and 4. Where such values of full load current and input power are not specified, the same shall be declared by the manufacturer.

b) Non- overloading of the prime-mover in the declared operating head range at rated voltage when supply frequency is within the limits of ± 3 percent of rated frequency.

c) Rated output of the motor: The declared motor rating shall be in accordance with relevant Table 1, 2, 3 and 4.

d) Full load speed of the motor. The declared speed of the motor shall not be less than the value specified in Table 1, 2, 3 and 4.

e) Overall efficiency of pumpset/monoset. The declared value of overall efficiency shall not be less than 0.955 times of the declared value.

f) Maximum self-priming time at static suction lift of 3 m for self-priming pumps and 1.5 m for semi self priming pumps shall not exceed 180 s.

15.2.2 *Bare Pumps*

a) Discharge and total head as per guaranteed duty point at rated voltage and speed.

b) Non-overloading of the prime-mover in the declared operating head range at rated voltage and speed.

c) Non-over-rated prime-mover recommended by the manufacturer; and

d) Maximum self-priming time at static suction lift of 3 m for self-priming pumps and 1.5 m for semi self priming pumps shall not exceed 180 s.

15.3 Tolerances

15.3.1 At rated voltage and frequency in case of monoset pump and at rated speed in case of bare pumps, the pump shall provide discharge and total head at guaranteed duty point within a tolerance of maximum -10 percent on total head and -10 percent on discharge.

15.3.2 The prime-mover of the monoset pump shall not get overloaded in the declared operating head range at rated voltage when the supply frequency is within the limits of ±3 percent of the rated frequency. The maximum allowable current shall be 1.07 times the value of declared full load current at guaranteed duty point.

15.3.3 The input power (IP) consumption in the declared operating head range in case of monoset pumps shall not be more than 1.10 times the value of declared input power at guaranteed duty point.

15.3.4 The prime-mover rating in case ofbare pumps recommended by the manufacturer shall not be more than 1.10 times the maximum value of pump input power (PIP) consumption observed in the declared operating head range or the immediate next higher rating specified in column 1 of Table 1 and 3.

15.3.5 The operating head range declared by the manufacturer shall not be less than ±25 percent of the guaranteed duty point head.

15.3.6 The test speed in case of bare pumps shall be within ±5 percent of the rated speed declared by the manufacturer.

15.4 Guarantee Verification Procedure

15.4.1 *Monoset Pumps*

15.4.1.1 *Discharge (Q) versus Total head (H), Input Power (IP) and Current (I)*

a) Test readings of Q, H and IP corrected for rated frequency and current (I) shall be plotted on a graph and continuous regular curves drawn. Plot guaranteed duty point Q_G-H_G on this graph (*see* Fig.11). If the guaranteed duty point lies below the Q-H curve, pump shall be deemed to have conformed to the head and discharge requirements. If the guaranteed duty point lies above the test Q-H curve, then vertical distance (ΔH) and horizontal distance (ΔQ) are found from the graph and the following equation shall be evaluated. (*see* Fig. 12).

$$\left(\frac{H_G \times X_H}{\Delta H}\right)^2 + \left(\frac{Q_G \times X_Q}{\Delta Q}\right)^2 \geq 1$$

Where X_Q and X_H are agreed tolerances applicable to Q and H respectively

$$X_Q = 0.1$$

$$X_H = 0.1$$

The pump shall be deemed to have conformed to the head and discharge requirements if it satisfies the above equation.

b) For verification of input power (IP) and the current (I) at the guaranteed duty point. Draw a straight line through the origin and guaranteed duty point Q_G-H_G on the above test graph to intercept the Q-H curve (*see* Fig. 11). Vertical line shall then be drawn through the point of intersection on Q-H curve to intersect the test Q-IP and Q-I curve. If the maximum value at the point of intersection on test Q-IP and Q-I curve is not more than the declared value the pumpset shall be deemed to have conformed to the input power and current requirement.

c) For verification of non-overloading of the pumpset, horizontal lines shall be drawn on the above test graph at minimum and maximum head in the declared operating head range, to intersect the test Q-H curve (*see* Fig. 13). Vertical lines shall then be drawn through the points of intersection to intersect the test Q-I curve. If the maximum value of current between the points of intersection on test Q-I curve is not more than 1.07 times the declared value of maximum current at the guaranteed duty point head, the pumpset shall be deemed to have conformed to the non-overloading requirement

d) For verification of minimum full load speed, rated output and nominal efficiency of the motor, dynamometer, torque meter or segregated loss method test shall be carried out as specified in IS 7572 or IS 4029. The motor shall be deemed to have conformed to the requirements if the values of output power, speed and efficiency at full load are not less than the values specified in Table 1, 2, 3 and 4.

e) For verification of self-priming time at a minimum static suction lift of 3m for self-primingpumps and 1.5 m for semi self priming pumps, the test procedure shall be as described in **12.5**.

The pump shall be deemed to have conformed to the requirement of self-priming time if the observed value is less than or equal to the declared value.

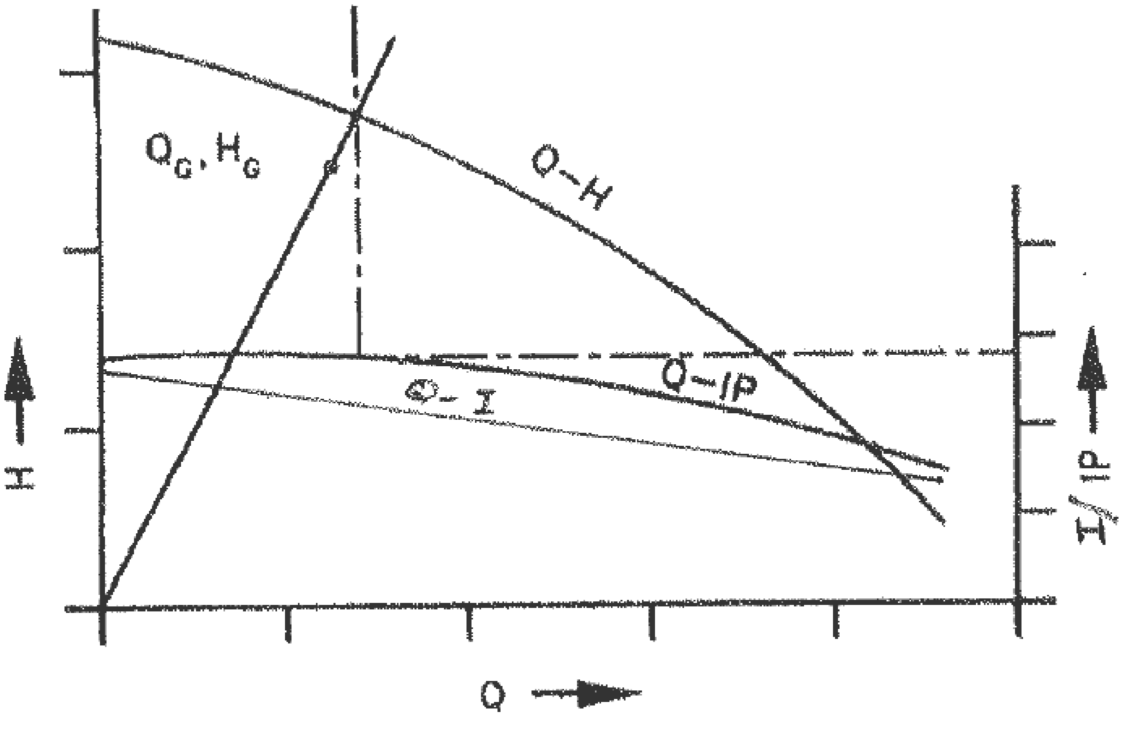


FIG. 11 CURVES FOR VERIFICATION OF GUARANTEE Q-H, Q-IP, Q-I AT RATED SPEED

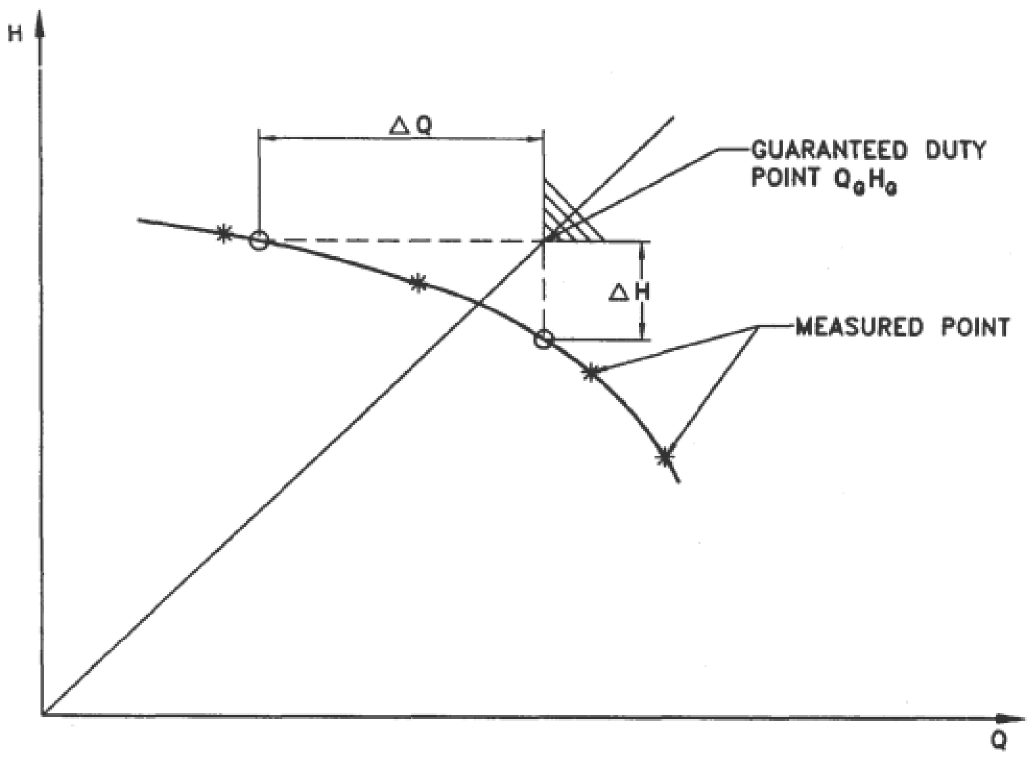


Fig. 12 Curves for Verification of Guarantee Q-H at Rated Speed. Where the Curve is Below Q_G, H_G

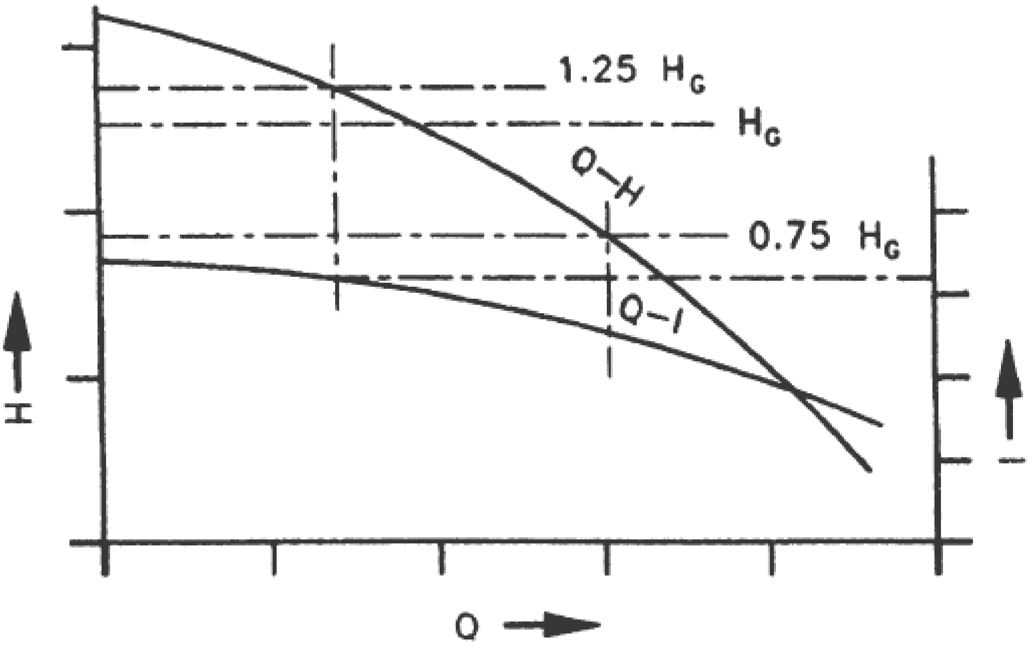


Fig. 13 Curves for Verification of Guarantee Q-H, Q-I – Observed Test Reading

15.4.2 *Bare Pumps*

a) Test readings of Q, H and PIP corrected for rated speed shall be plotted on a graph and continuous regular curves drawn. Plot guaranteed duty point Qg-Hg on this graph (*see* Fig. 11). If the guaranteed duty point lies below the Q-H curve, pump shall be deemed to have conformed to the head and discharge requirements. If the guaranteed duty point lies above the test Q-H curve, then vertical distance (ΔH) and horizontal distance (ΔQ) are found from the graph and the following shall be evaluated.

$$\left(\frac{H_G \times X_H}{\Delta H}\right)^2 + \left(\frac{Q_G \times X_Q}{\Delta Q}\right)^2 \geq 1$$

Where, X_Q and X_H are agreed tolerances applicable to Q and H respectively

$$X_Q = 0.1$$

$$X_H = 0.1$$

The pump shall be deemed to have conformed to the head and discharge requirements if it satisfies the above equation.

b) For verification of non-overloading of the recommended prime-mover**,** horizontal lines shall be drawn on the above test graph at minimum and maximum head in declared operating head range, to intersect the test Q-H curve. Vertical lines shall than be drawn through the points of intersection to intersect the test Q-PIP curve. If the maximum value of input power to the pump between the points of intersection on test Q-PIP curve is not more than recommended prime-mover rating, the pump shall be deemed to have conformed to the non-overloading requirement. A calibrated prime-mover shall be used for conducting the above test. Correction shall be made for power losses between the driving element and the pump under test. Power delivered to the pump shaft when directly coupled shall be the power output of the driving element. When not directly coupled, correction shall be made for the power losses. In the case of flat belt and V-belt drives, the allowances for belt losses shall be taken at 6 and 3percent for single belt, respectively.

c) For verificationof non-over rated prime-mover, it shall be deemed to have conformed to the requirement, if the prime-mover rating is not more than 1.10 times the maximum value of the pump input power (PIP) in the declared operating head range observed from the test Q-PIP curve described in **17.4.2**(b) or the immediate next higher rating specified in Table 1, 2, 3 and 4.

Table 1 Values of Performance Characteristics of Capacitor Start Capacitor Run (CSCR) / Capacitor Start and Run (CSR), Single Phase, 2-Pole A.C. Motors at Rated Conditions of 240 V, 50 Hz for Centrifugal Regenerative Monoset Pumps

Sl No.	**Rated Output** (kW)	**Minimum Full Load Speed** (rpm)	**Rated Current** (A)	**Permissible Limit of Maximum Current in Operating Head Range for Checking Non-overloading Requirements** (A)	**Minimum Breakaway (Starting) Torque (In Terms of Full Load Torque) for CSR Motor** (Percent)	**Minimum Breakaway (Starting) Torque (In Terms of Full Load Torque) for CSCR Motor** (Percent)	**Nominal Motor Efficiency** (Percent)	**Maximum Input power** (kW)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	0.18	2600	2.1	2.2	30	150	54	0.382
ii)	0.25	2625	2.8	3.0	30	150	56	0.506
iii)	0.37	2650	3.7	4.0	30	150	59	0.738
iv)	0.55	2700	5.0	5.4	30	150	63	0.957
v)	0.75	2725	6.2	6.6	30	150	67	1.209
vi)	1.10	2750	8.6	9.2	30	150	70	1.679
vii)	1.50	2750	11.5	12.3	30	150	70	2.290

NOTES:

1 Maximum current limits specified are for 240 volt rated voltage. For other voltages, it shall be in inverse proportion of rated voltage.

2 Unless otherwise specified, tolerance on performance characteristics shall be in accordance with Table 7 of IS 14582. Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant. In case of superior value of efficiency declared by the manufacturer, the tolerance indicated in Table 7 of IS 14582 is not applicable and the motor on verification should conform to the declared value.

Table 2 Values of Performance Characteristics of Capacitor Start Capacitor Run (CSCR) / Capacitor Start and Run (CSR), Single Phase, 4-Pole A.C. Motors at Rated Conditions of 240 V, 50 Hz for Regenerative Monoset Pumps

Sl No.	Rated Output (kW)	Minimum Full Load Speed (rpm)	Rated Current (A)	Permissible Limit of Maximum Current in Operating Head Range for Checking Non-Overloading Requirements (A)	Minimum Breakaway (Starting) Torque (In terms of Full Load Torque) (Percent) for SR motor	Minimum Breakaway (Starting) Torque (In Terms of Full Load Torque) (Percent) for CSCR Motor	Nominal Motor Efficiency (Percent)	Maximum Input power (kW)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	0.18	1275	2.1	2.2	30	150	54	0.382
ii)	0.25	1300	2.8	3.0	30	150	56	0.506
iii)	0.37	1325	3.9	4.2	30	150	58.5	0.709
iv)	0.55	1350	5.3	5.7	30	150	62	0.977
v)	0.75	1350	6.6	7.1	30	150	66	1.232
vi)	1.10	1375	9.1	9.7	30	150	69	1.709
vii)	1.50	1375	12.2	13.1	30	150	70	2.290

NOTES:

1 Maximum current limits specified are for 240 volt rated voltage. For other voltages, it shall be in inverse proportion of rated voltage.

2 Unless otherwise specified, tolerance on performance characteristics shall be in accordance with Table 7 of IS 14582**.** Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant. In case of superior value of efficiency declared by the manufacturer, the tolerance indicated in Table 7 of IS 14582 is not applicable and the motor on verification should conform to the declared value.

Table 3 Values of Performance Characteristics of Three Phase, 2-Pole A.C. Motors at Rated Conditions of 415 V, 50 Hz for Centrifugal Regenerative Monoset Pumps

Sl No.	Rated Output (kW)	Minimum Full Load Speed (rpm)	Rated Current (A)	Permissible Limit of Maximum Current in Operating Head range for Checking Non-Overloading Requirements (A)	Minimum Breakaway (Starting) Torque (In Terms of Full Load Torque) (Percent)	Nominal Motor Efficiency (Percent)	Maximum Input Power (kW)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	0.37	2720	1.3	1.4	170	63	0.644
ii)	0.55	2760	1.7	1.8	170	67	0.886
iii)	0.75	2780	2.1	2.2	170	71	1.125
iv)	1.10	2790	2.9	3.1	170	73	1.595
v)	1.50	2800	3.9	4.2	170	76	2.072
vi)	2.20	2810	5.2	5.6	170	78	2.945
vii)	3.70	2820	8.3	8.9	160	81	4.734
viii)	5.50	2830	11.4	12.2	160	82	6.936
ix)	7.50	2840	15.6	16.7	160	83	9.323

NOTES:

1 Maximum current limits specified are for 415 volt rated voltage. For other voltages, it shall be in inverse proportion of rated voltage.

2 Unless otherwise specified, tolerance on performance characteristics shall be in accordance with Table1 of IS 7538Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant. In case of superior value of efficiency declared by the manufacturer, the motor on verification should conform to the declared value and the tolerance indicated in Table 20 of IS/IEC 60034-1 is not applicable.

Table 4 Values of Performance Characteristics of Three Phase, 4-Pole A.C. Motors at Rated Conditions of 415 V, 50 Hz for Regenerative Monoset Pumps

Sl No.	Rated Output (kW)	Minimum Full Load Speed (rpm)	Rated Current (A)	Permissible Limit of Maximum Current in Operating Head Range for Checking non-Overloading Requirements (A)	Minimum Breakaway (Starting) Torque (In Terms of Full Load Torque) (Percent)	Nominal Motor Efficiency (Percent)	Maximum Input Power (kW)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	0.37	1330	1.5	1.6	170	64	0.631
ii)	0.55	1340	1.8	1.9	170	69	0.855
iii)	0.75	1360	2.3	2.5	170	71	1.125
iv)	1.10	1370	3.0	3.2	170	73	1.595
v)	1.50	1380	4.0	4.3	170	76	2.072
vi)	2.20	1390	5.3	5.7	170	79	2.900
vii)	3.70	1410	8.4	9.0	160	83	4.599
viii)	5.50	1420	11.9	12.7	160	84	6.740
ix)	7.50	1430	16	17.1	160	85	9.063

NOTES:

1 Maximum current limits specified are for 415 volt rated voltage. For other voltages, it shall be in inverse proportion of rated voltage.

2 The permissible limit of maximum current above 15 kW shall be declared by the manufacturer. However, the declared value of nominal efficiency shall not be less than that of 15 kW value.

3 Unless otherwise specified, tolerance on performance characteristics shall be in accordance with Table1 of IS 7538.Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant. In case of superior value ofefficiency declared by the manufacturer, the motor on verification should conform to the declared value and the tolerance indicated in Table 20 of IS / IEC 60034-1 is not applicable.

Table 5 Priming Time Conversion Factor

Sl No.	Suction Pipe Used for Testing (mm)	Nominal Suction Pipe Size Same as Pump Suction, mm										
i)		10	15	20	25	32	40	50	65	80	90	100
ii)	15	1.68	—	—	—	—	—	—	—	—	—	—
iii)	20	3.23	1.92	—	—	—	—	—	—	—	—	—
iv)	25	5.10	3.00	1.57	—	—	—	—	—	—	—	—
v)	32	9.05	5.36	2.80	1.78	—	—	—	—	—	—	—
vi)	40	12.40	7.40	3.85	2.45	1.37	—	—	—	—	—	—
vii)	50	20.20	12.00	6.25	4.00	2.23	1.62	—	—	—	—	—
viii)	65	34.60	20.60	10.70	6.80	3.82	2.78	1.72	—	—	—	—
ix)	80	48.20	28.50	14.90	9.50	5.32	3.88	2.38	1.34	—	—	—
x)	90	—	38.40	20.00	12.80	7.15	5.20	3.20	1.87	1.34	—	—
xi)	100	—	49.00	25.50	16.20	9.10	6.62	4.06	2.37	1.71	1.27	—

16 MARKING

16.1 Monoset Pump

A name plate shall be affixed on the monoset pump with the following parameters:

a) Manufacturer’s name or regd. trade mark;

b) Model;

c) Type;

d) Serial No.;

e) Size (nominal size of suction and delivery pipe) (mm);

f) Total head (m) and discharge (lpm) at guaranteed duty point;

g) Head range (m) for non-overloading prime-mover requirement;

h) Motor / Engine rating (kW);

j) Rated Voltage (V);

k) Rated frequency (Hz);

m) Number of phases;

n) Number of poles;

p) Winding connection (CSCR/ CSR, Delta, Star);

q) Capacitor rating (MFD) and voltage (V);

r) Maximum current (amp.) at guaranteed duty point; and

s) Class of insulation;

t) Maximum input power (kW) at guaranteed duty point;

u) Overall efficiency of pumpset/monoset (percent);

w) Full load speed of the motor / engine (rpm);

y) No. of stages; and

z) Self priming time at 3.0 m suction lift for self priming pumps and 1.5 m suction lift for semi self priming pumps.

NOTES:

1 For prime-movers other than electric motor, parameters j), k), m), n), p), q), r), s), t), u) and w) shall not be applicable.

2 The overall efficiency percent of monoset marking is to create an awareness to the end user regarding the lower efficiency of these types of pumps as an information.

16.2 Bare Pump

A name plate shall be affixed on the pump with the following parameters:

a) Manufacture name or regd. trade mark;

b) Model;

c) Type;

d) Serial No.;

e) Size**:** nominal size of suction and delivery pipe (mm);

f) Number of stages;

g) Total head (m) and discharge (lpm) at guaranteed duty point;

h) Rated speed (rpm);

j) Head range (m) for non-overloading prime-mover requirement; and

k) Recommended prime- mover rating (kW).

16.3 BIS Certification Marking

The centrifugal regenerative pump may also be marked with the Standard Mark.

16.3.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
210 : 2009	Grey iron castings — Specification (*fourth revision*)
304 : 1981	High tensile brass ingots and castings
318 : 1981	Specification for leaded tin bronze ingots and castings (*second revision*)
1239 (Part 1) : 2004	Steel tubes, tubulars and other wrought steel fittings: Part 1 Steel tubes
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machines
4029 : 2010	Guide for testing three phase induction motors
4984 : 2016	High density polyethylene pipes for potable water supplies
4985 : 2000	Unplasticized PVC pipes for potable water supplies
5120 : 1977	Technical requirements for rotodynamic special purpose pumps
6603 : 2001	Stainless steel bars and flats
6912 : 2005	Copper and copper alloy forging stock and forgings
7347 : 1974	Performance of small size spark ignition engines for agricultural sprayer and similar applications
7538 : 1996	Three-phase squirrel cage induction motors for centrifugal pumps for agricultural applications
7572 : 1974	Guide for testing single-phase AC and universal motors
10572 : 1983	Methods of sampling for pumps
11170 : 1985	Performance requirements for constant speed compression ignition (diesel) Engines For Agricultural Purposes (Up to 20 kw)
11346 : 2002	Code of acceptance tests for agricultural and water supply pumps (*first revision*)
12231 : 1987	Unplasticized PVC pipes for use in suction and delivery lines of agricultural pump sets
14582 : 1998	Single-phase small a.c. electric motors for centrifugal pumps for agricultural applications
IS/IEC 60034 -1 : 1996	Rotating electrical machines: Part 1 Rating and performance

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Amendments Issued Since Publication

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